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Biology and Habitat Usage of Sympatric Populations of the Fawn-footed Melomys (*Melomys cervinipes*) and the Grassland Melomys (*M. burtoni*) (Rodentia: Muridae)

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ABSTRACT

A mark-recapture study of small mammals was conducted in a swamp-forest association on Kinaba Island and adjacent mainland, Cooloola, Over 15,527 trap-nights and 9,891 trap-days, 34 individual male and 27 female *M. cervinipes* and 43 individual male and 31 female *M. burtoni* were trapped. *M. cervinipes* were found to breed from August to January, whilst there was no clear season for *M. burtoni* which bred throughout the year. Adult *M. cervinipes* and *M. burtoni* are noticeably different in size. *M. cervinipes* density increased over the study while that of *M. burtoni* decreased. A dry change in the environment was possibly responsible for these population dynamics. *M. cervinipes* and *M. burtoni* have different habitat requirements and so are typically segregated in space. Clear ecological and biological differences in the two species must help to alleviate competition between them.

INTRODUCTION

The Fawn-footed Melomys (*Melomys cervinipes*) is usually found in closed forest, but may also occur outside this habitat type (Watts and Aslin 1981). It has previously been recorded in coastal mangrove forests by Lavery and Johnson (1974). Populations have been studied by Wood (1971) and Freeland (1972) in sub-tropical rainforest, but in general capture data is sparse, and biology and population characteristics poorly known elsewhere (cf. Watts and Aslin 1981).

The Grassland Melomys (*M. burtoni*) is smaller than *M. cervinipes*. It typically inhabits tropical and sub-tropical grasslands, sedgeland and open forest or woodland with a grassy understorey (Watts and Aslin 1981). It has also been trapped in canefields of north Queensland (Gard 1935, McDougall 1944 and 1946, Redhead 1973). Comparatively little is known about the biology of the Grassland Melomys (Watts and Aslin 1981).

Melomys cervinipes and *M. burtoni* are known to be sympatric over parts of their range. In this study *M. cervinipes* and *M. burtoni* were trapped in a swamp-forest association on Kinaba Island in Lake Cootharaba and on the adjacent mainland in the Cooloola 'wallum' of southeastern Queensland (Coaldrake 1961). Hockings (1977), Dwyer, Hockings and Willmer (1979) and Dwyer, Kikkawa and Ingram (1979) have also trapped both species in the 'wallum' country. They found *M. cervinipes* to be most clearly associated with closed forest and *M. burtoni* most abundant in wet-heathland.

For Kinaba Island and nearby mainland, information on trapping success, breeding biology, weight, longevity, trappability, population density and structure,

Fig. 1. Location of the study site.

home range, movements and utilization of space are given for both species. Trapping returns were low for both species.

STUDY AREA AND METHODS

The work described here was carried out at Kinaba Island and on the adjacent mainland (lat. 26°14′S, longit. 153°02′E; see Figs. 1 and 2). The island lies at the southern end of the Cooloola National Park. The region has been broadly described as "wallum' (Coaldrake 1961). The island and adjacent mainland is dominated by the Swamp Oak (*Casuarina glauca*) and the Paperbark (*Melaleuca quinquenervia*), which both grow to 20 metres. A more detailed description of the study site has been given by Smith (1984) and of the Cooloola region by Dwyer, Hockings and Willmer (1979). The island undergoes infrequent inundation and it appears that it was formed by alluvial deposition.

Climatic conditions experienced at Kinaba Island and the whole of the Cooloola region were described by Smith (1984) and Dwyer, Hockings and Willmer (1979), respectively.

Melomys cervinipes and *M. burtoni* were trapped in Elliott traps (33 x 20 x 10 cm) and larger wire traps (40 x 15 x 20 and 52 x 20 x 25 cm). Trapping sessions were in May, mid-June, late July-early August and Mid-September, 1976, and monthly from January, 1977 to January, 1979.

In Fig. 2, Areas 1, 2 and 7A and 7B are the sites where trapping grids occurred. Grid lines and trap points in each line were 20 metres apart. The 'effective' sampling areas of these grids are taken to include a 10 metre boundary strip (where possible) around the outer margin of traps. Line transects were established in Areas 3, 4, 5 and

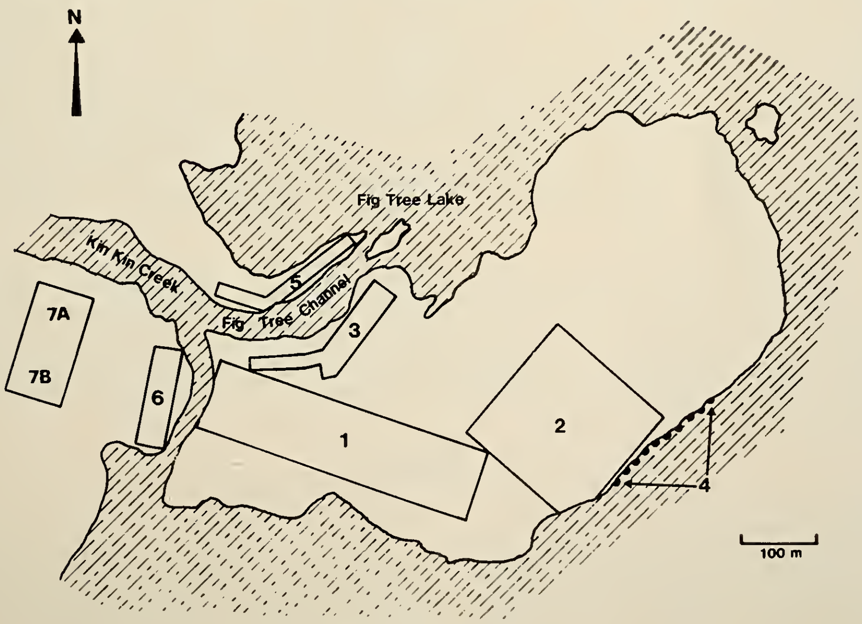

Fig. 2. Details of study area showing trapping areas.

6 (Fig. 2). Adjacent trap lines and trap-sites in lines were also 20 metres apart. The numbers of trap-sites in Areas 1, 2, 3, 4, 5, 6, 7A and 7B were 100, 97, 20, 10, 12, 14, 32 and 32 respectively. Areas 7A and 7B contained 16 trap-sites in common. One trap was placed at each site. Areas 3 and 4 were trapped in two and three sessions respectively. Areas 5 and 6 were established to monitor transfers from island to mainland and vice versa. In each area, traps were operated for between two to four consecutive nights in any one trapping period. Traps were left open but unbaited through the day. They were baited in the late afternoon with bacon and sweet potato soaked in vegetable oil and cleared the next morning.

On Kinaba Island traps were operated over 13,803 trap-nights and 8,887 trap-days. On the mainland, 1,724 trap-nights and 1,004 trap-days were logged.

At first capture, animals were individually marked by toe-clipping. At this time and at each recapture, the following information was recorded: For females (1) condition of the vagina (a) perforate or imperforate, (b) with or without sperm plug; (2) teat condition (a) small, medium, large or regressed (b) lactating on palpation or not lactating; (3) evidence of pregnancy, discerned by palpation. Palpation was only successful for later stage pregnancies. Undetected pregnancies were evidenced by teat enlargement during lactation. Reproductive condition of males was coded as: *Testes 1* (testes not descended into the scrotal sac), *Testes 2* (testes scrotal but small), *Testes 3* (Medium to large scrotal testes with an unenlarged cauda epididymal sac), *Testes 4* (Large scrotal testes with cauda epididymal sac enlarged), and *Testes 4-* (Testes that had previously been Testes 4 but with the cauda epididymal sac collapsed). Breeding refers to the birth and nursing of young.

Known to be alive (KTBA) estimates of population size were used (Krebs 1966). Retrappability indices assess how easily animals are caught by the use of trapping techniques and these indices can be subsequently used to determine KTBA exclusion periods (see Hockings 1977). Average retrappability for *M. cervinipes*, both sexes combined, was 0.5 ($s = 0.42$, $n = 16$). The species is trap 'shy' (cf. Wood 1971, Hockings 1977; Fletcher 1978) and for this reason individuals were only excluded from KTBA estimates if absent for more than four trapping sessions. For *M. burtoni*, average retrappability for the island, both sexes combined, was 0.63 ($s = 0.33$, $n = 9$). Individuals were excluded from KTBA estimates if absent for greater than two trapping sessions. Retrappability for the mainland was lower ($\bar{x} = 0.43$, $s = 0.43$, $n = 17$) and thus individuals were only excluded from KTBA estimates if absent for greater than four trapping sessions. Differences in trappability between island and mainland are more likely to reflect inadequacies in the trapping programme than actual differences intrinsic to the populations.

Transients include those individuals caught either in one trapping period only, or in single periods separated by intervals greater than the KTBA inclusion period. Because transience may be correlated with the proportion of traps on the perimeter of a grid, the differently shaped grids may influence this measure. Indices of home range size were calculated using Brant's (1962) measure of average distance between successive captures (AvD measure). Distances between captures were measured within grids only and not between grids and lines.

RESULTS

Trapping Success

Thirty males and 27 females *M. cervinipes* were trapped on Kinaba Island a total of 215 times. The sex ratio was 1:1 ($X^2 = 0.07$, $df = 1$, $P>0.05$). Four individual males were trapped a total of five times on the mainland. Capture rates for the island and mainland were 1.55% and 0.29% respectively.

Eleven *M. burtoni* females and 23 males were trapped on the island and this was significantly biased from 1:1 ($X^2 = 6.08$, df $= 1$, $P<0.05$). These individuals were trapped 155 times, a capture rate of 1.2%. Three captures on the island were made during daylight hours (% capture rate = 0.03%). Twenty females and 20 males were captured a total of 98 times on the mainland, a capture rate of 6.12%.

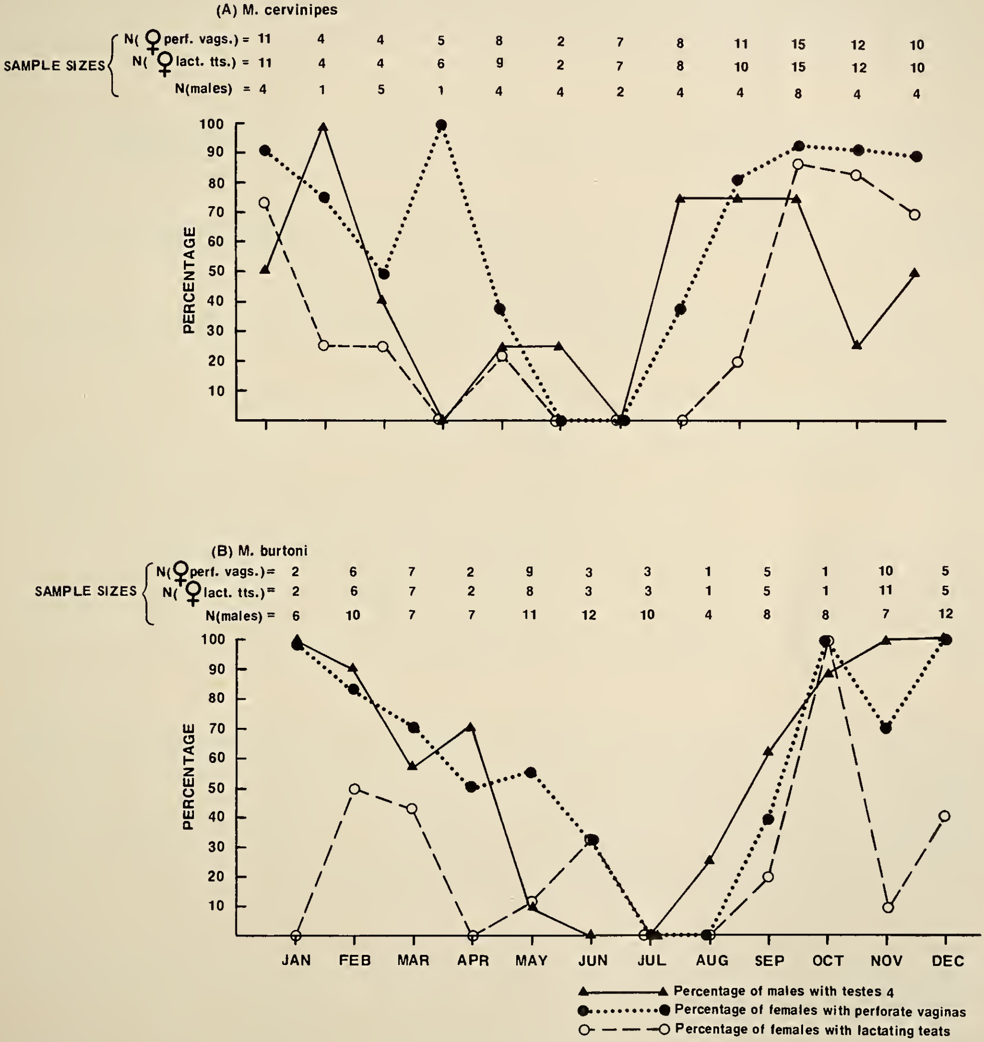

Fig. 3. Reproductive data for (A) *M. cervinipes* and (B) *M. burtoni*. Data pooled from all years.

Breeding

Data relevant to determining breeding periods are given in Fig. 3 for both species.

M. cervinipes

Males with Testes 4 were uncommon (i.e. proportions $\leqslant$ 0.4) from March to July (i.e. autumn to winter). One adult male with regressed testes was trapped in May, 1978 and another in June, 1977.

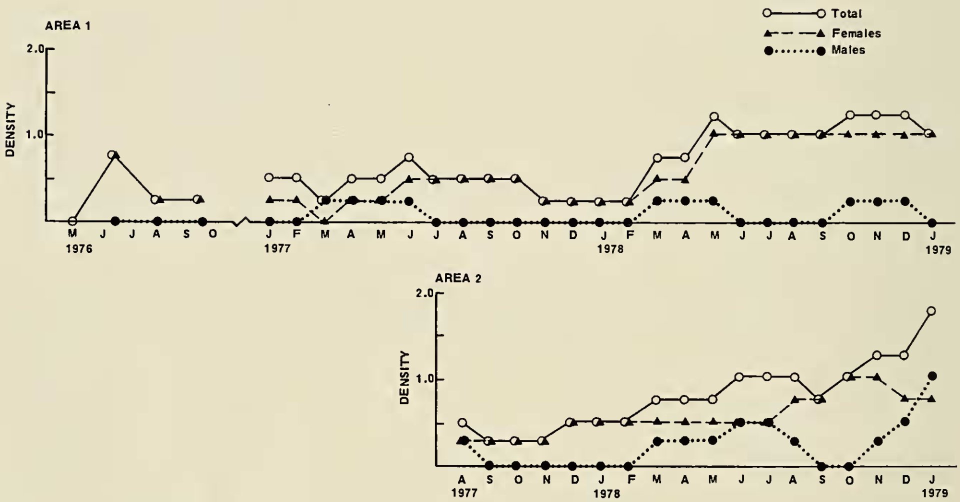

Fig. 4. Densities (residents/ha) of *M. cervinipes* from KTBA estimates in areas 1 and 2.

No females with perforate vaginas were trapped through the winter months of June or July. Five females that had previously been perforate became sealed between May and August. Two females with lactating teats were trapped in September, thus some mating activity that resulted in fertilisation must have occurred through the winter months (assuming a 38 day gestation period, Watts and Aslin 1981). Lactating females were most commonly encountered between October and January (i.e. spring to mid-summer).

The data for males and females combined seem to suggest that most successful mating encounters and subsequent breeding activity occurs between August and January and that occurrences outside this period are rare.

A maximum of two litters per female in a breeding season was recorded, although the average rate of pregnancy per female per season was 1.3 (s = 0.77, n = 18).

M. burtoni

Evidence of breeding on Kinaba Island came from Area 4 only. A pregnant female was trapped in November, 1978 and two females with lactating teats were trapped in December, 1978. Males with Testes 4 and females with perforate vaginas were recorded from Areas 1, 2 and 4. Evidence of breeding was noted in all mainland areas.

Males with Testes 4 were trapped in all months except June and July. Some regression of testes occurred in these months, as well as in May, August and October.

Lactating females were caught in all months other than January, April, July and August. The proportions of females with perforate vaginas were at a minimum in June and July.

In general, breeding activity appears to decline during the cooler months, but no main breeding season was identified.

Weights and Longevity

M. cervinipes

Male *M. cervinipes* attained adult weights ranging between 61g and 102g ($\bar{x}$= 83.1, s= 10.96, n= 29) and females (pregnant females included weights between 55g and 115g ($\bar{x}$= 73.2, s= 11.62, n= 113). The lightest male trapped weighed 18g and the lightest female 17g. Both these individuals were trapped in October 1978 and had probably recently been weaned.

A male that was trapped over 16 months after its sexual maturation at four to six months (Freeland 1972) was estimated to have been approximately 21 months at last capture. A female that was first captured as an adult was trapped over 17 subsequent months. Its age when last trapped must have been at least 23 months.

M. burtoni

Male *M. burtoni* grew to weights that ranged between 47g and 67g ($\bar{x}$= 56.5, s= 5.16, n= 100) and females (pregnant females included) 26g to 58g ($\bar{x}$= 42.9, s= 7.09, n= 51). The lightest juvenile male caught weighed 23g and the lightest female 12g. P. Dwyer (pers comm.) has recorded 11g juveniles attached to teats, thus the latter individual was probably recently weaned.

Population Characteristics

M. cervinipes

Population densities of residents for Areas 1 and 2 are graphed in Fig. 4. Numbers of individuals caught in each trapping period are given in Table 1. No regular pattern in population fluctuations emerged. The increase in density in 1978 compared with the other years was due to an influx of mainly subadult

TABLE 1. Total number of individuals (including transients) caught in each trapping session.

		M. cervinipes		*M. burtoni*				
Trapping Period		Area 1	Area 2	Area 1	Area 2	Area 6	Area 7A	Area 7B
May	1976	0		5				
mid-June		4		6				
August		1		1				
mid-Sep.		1		0				
Jan.	1977	2		2				
Feb.		2		4		1		
March		2		2		2		
April		1		1			0	
May		3		2		2		
June		3		1		2	7	
July		1		1		0	8	
August		1	2	0	2	0		
Sep.		2	1	1	0	1	8	
Oct.		5	1	0	1	1		
Nov.		3	2	0	1		10	
Dec.		1	2	1	3	1		
Jan.	1978	1	2	1	2	1		2
Feb.		0	3	0	5	1		
March		4	3	3	2			3
April		2	4	3	4			
May		7	1	2	1			6
June		0	2	1	2			
July		3	3	1	2			0
August		1	6	0	1			
Sep.		6	4	0	2			1
Oct.		7	9	1	3			0
Nov.		6	5	0	1			2
Dec.		5	6	0	1			2
Jan.	1979	4	7	0	0			0

individuals that were probably born during the spring to early summer period of 1977-78. The maximum density recorded (including transients) was 2.32 individuals per hectare in October 1978.

M. burtoni

Density estimates based on KTBA estimates are given in Fig. 5. Total numbers of individuals caught per trapping period are given in Table 1. The pattern of population fluctuation in Area 1 was regular from year to year. Evidently, individuals resided only temporarily in Area 1 during the summer months. Males made up a large proportion of the individuals in this area.

Compared with Area 1, population fluctuations in Area 2 did not show comparable trends. Numbers, which consisted principally of males, remained constant.

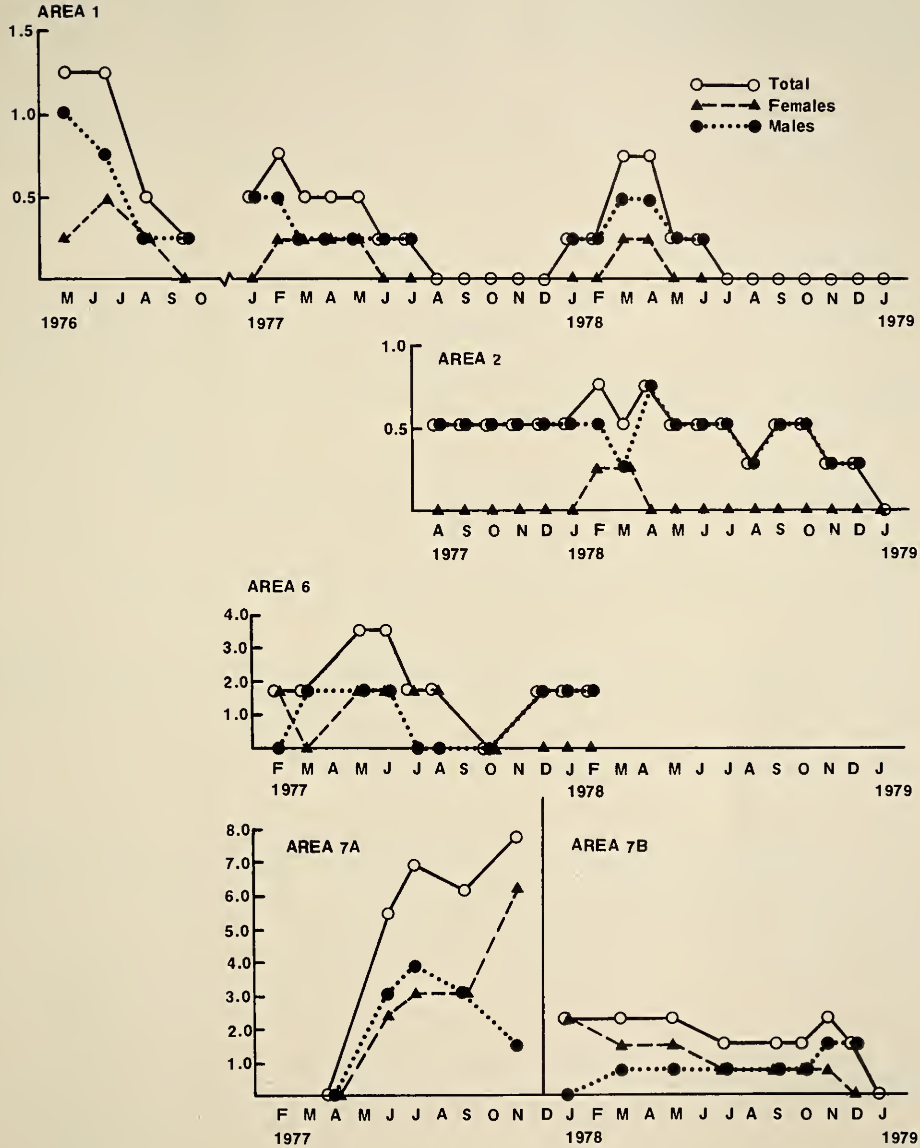

Fig. 5. Densities (residents/ha) of *M. burtoni* from KTBA estimates. Areas 1 and 2 = Kinaba Island. Areas 6, 7A and 7B = mainland.

On the mainland, no temporal trends in abundance for any area were evident. Nor was there similarity with island trapping areas. There was evidence that population numbers peaked prior to winter but declined during the ensuing cold months.

There was a decrease in the density of *M. burtoni* on Areas 1, 2 and 7B towards the end of the study. The highest densities recorded for the island and mainland were 1.51 and 7.81 individuals per hectare, respectively.

Transience and Home Range

M. cervinipes

The numbers of individuals classified as transients and as residents for Areas 1 and 2 are given in Table 2. Transients were more common than residents in Area 1, but equally as common in Area 2. The high transient estimates reflect difficulties experienced in trapping the species.

Home ranges both within and between sexes overlapped. Male movements (AvD= 71.52 metres, s= 35.50, n= 7) were significantly greater than those of females (AvD= 46.16 metres, s= 14.66, n= 14) (Mann Whitney U= 19, n_1= 7, n_2= 14, $P<0.05$). One female first captured on the mainland as a subadult was subsequently recaptured 14 months later on the island.

M burtoni

The numbers of individuals classified as transients and as residents are given in Table 2. In Area 7A residents were more abundant than transients, but in all other areas the ratio of transients to residents was 1:1.

TABLE 2. Numbers of individuals classified as transients and as residents for *M. cervinipes* in Areas 1 and 2, and for *M. burtoni* in Areas 1, 2, 7A and 7B. Results of X^2 analyses testing for bias from a 1:1 ratio are given. Expected values in parentheses.

M. cervinipes			
	Transients	Residents	X^2 analyses
Area 1	24 (17.5)	11 (17.5)	X^2_{adj} = 4.11, df = 1, P<0.05
Area 2	10 (9)	8 (9)	X^2_{adj} = 0.06, df = 1, P<0.05
M. burtoni			
	Transients	Residents	X^2 analyses
Area 1	8 (9.5)	11 (9.5)	X^2_{adj} = 0.21, df = 1, P>0.05
Area 2	6 (6)	6 (6)	–
Area 7A	2 (6)	10 (6)	X^2_{adj} = 4.08, df = 1, P<0.05
Area 7B	4 (4)	4 (4)	–

The AvD measure of 73.94 metres ($s = 52.37$, $n = 12$) calculated from island grid captures, males only, is likely to be an underestimate. Several records of dispersion across water barriers were made. Two individual males crossed the channels separating island and mainland at least twice each. Females also were rafted or swam across the channels.

Resource Utilization

Capture data for *M. cervinipes* and *M. burtoni* at each trap station were tested in pair-wise combination using Spearman Rank Correlation analysis. In Area 1 no relationship was evident ($r_s = -0.1139$, $t = -1.135$, $df = 98$), but in Area 2 captures were negatively correlated ($r_s = -0.3051$, $t = -3.123$, $df = 95$). Either mutual exclusion occurred between species or they preferred different vegetation types. This has not been tested here.

All captures of breeding *M. burtoni* females occurred in the two trapping lines adjacent to the island edge in Area 2; in Area 4; and in Areas 5, 6, and 7A of the mainland.

DISCUSSION

Breeding

If breeding activity of *M. cervinipes* is restricted to between the months of August and January as the data suggest, then the main breeding season is relatively short compared to populations in rainforest at Mt Glorious, southeastern Queensland (cf. Wood 1971, Freeland 1972). Some females produced more than one litter per year and this is not uncommon for *M. cervinipes* (cf. Taylor and Horner 1970, Freeland 1972).

At Kinaba Island and in the adjacent mainland, no obvious breeding season was evident for *M. burtoni.* In other localities at Cooloola parturition occurs mainly between September and March, although some winter breeding activity is evident (Hockings 1977). McDougall (1946) found that this species breeds mainly in autumn and winter in north Queensland. Breeding females were found on the island perimeter and in mainland areas only, where the habitat consisted of dense stands of restiads, grasses and/or reeds in or near to permanent water. In this type of environment females are probably able to find suitable places to build nests (Gard 1935).

It seems that the breeding seasons of *M. cervinipes* and *M. burtoni* overlap considerably, but that the localities of nests are probably quite different. Such differences would alleviate any possible competition for nest space.

Weight

Within sex, adult *M. cervinipes* are typically heavier than *M. burtoni,* although there is a small overlap in the weight ranges (cf. Watts and Aslin 1981).

Population Phenomena

Poor trapping success of *M. cervinipes* stems from the inadequacy of traps placed on the ground for capturing this partly arboreal species. Hockings (1977), Barry (1977) and Dwyer, Hockings and Willmer (1979) noted that in areas where overhead runways were abundant, trapping returns probably led to underestimates of true densities within these habitats. The maximum recorded density of 1.8 individuals per hectare is less than half that noted for blackbutt-*Banksia aemula* forest near Ramsay's rainforest, Cooloola (cf. Dwyer, Hockings and Willmer 1979).

Variability in *M. burtoni* density and population dynamics between areas suggest differential usage of habitats. Animals of this species appear to prefer dense vegetation (Hockings 1977, pers obs). During periods through which space may be at a premium in these favoured areas, individuals may find it necessary to overflow into adjacent, suboptimal habitats. In late summer and winter, peripheral habitat was occupied by mostly males. The maximum density recorded in Area 7A on the mainland, is the highest yet known for the Cooloola region (cf. Dwyer, Hockings and Willmer 1979). This is not surprising considering that this wetland with dense vegetation at the shrub and herb levels is ideal habitat for *M. burtoni* (Hockings 1977, Watts and Aslin 1981).

Over the period of the study the densities of *M. burtoni* decreased on Areas 1 and 2 whilst *M. cervinipes* numbers increased. This is believed to be a response to low rainfall experienced late in the study which led to dry conditions, rendering the environment more suitable to occupation by *M. cervinipes* than *M. burtoni*.

Habitat Usage

M. cervinipes is adapted to an arboreal existence (Wood 1971, Freeland 1972, Fletcher 1978, pers obs). The tail is prehensile and on release animals frequently climbed a nearby tree or vine with considerable skill. *M. burtoni* also has a prehensile tail but its climbing is probably restricted to tall reeds and sedges (Watts and Aslin 1981) where it feeds. No *M. burtoni* climbed a tree or vine upon release. It would appear that although *M. cervinipes* and *M. burtoni* populations share a swamp-forest habitat on an island in the 'wallum' of southeastern Queensland, they segregate at a finer scale within this habitat.

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